	Application No.	Applicant(s)
Notice of Allowability	09/689,488	SMITH, KEVIN FRANK
	Examiner	Art Unit
	Zhuo H. Li	2185

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *10/31/2005*.

2. ☒ The allowed claim(s) is/are *1, 4, 7-8, 12-21, 23-27, 29-32*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a) ☐ All   b) ☐ Some*   c) ☐ None   of the:

        1. ☐ Certified copies of the priority documents have been received.

        2. ☐ Certified copies of the priority documents have been received in Application No. _____ .

        3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

    * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

    (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached

        1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____ .

    (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

    Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)

2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)

3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____

4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

5. ☐ Notice of Informal Patent Application (PTO-152)

6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .

7. ☒ Examiner's Amendment/Comment

8. ☒ Examiner's Statement of Reasons for Allowance

9. ☐ Other _____ .

EXAMINER'S AMENDMENT AND REASONS FOR ALLOWANCE

EXAMINER'S AMENDMENT

1.   An examiner's amendment to the record appears below. Should the changes

and/or additions be unacceptable to applicant, an amendment may be filed as provided by

37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no

later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview

with Brian C. Kunzler (Reg. No. 38,527) on November 9, 2005.

The application has been amended as follows:

Claim 22 is canceled.

Claim 8   The method of claim 1, wherein remotely modeling the <u>LRU</u> cache further

comprises periodically calculating a single reference residency time (SRRT) for ~~a~~

<u>the</u> data element within the <u>LRU</u> cache.

Claim 12   The method of claim 1, wherein assigning a priority value further

comprises assigning a priority value comprising the priority value assigned to the

preceding data element plus one when the preceding data element is found to be

present in the <u>LRU</u> cache.

Claim 13   The method of claim 1, wherein determining whether to schedule a

prefetch of ~~a~~ <u>the</u> data element further comprises comparing the priority value of

the requested element with a dynamic threshold.

Claim 14   The method of claim 13, further comprising prefetching the requested data

element into the LRU cache if the priority value of the requested data element is

greater than the dynamic threshold.

Claim 16   The method of claim 15, wherein periodically reevaluating the

performance of the remote module further comprises determining is a dynamic

threshold used in the remote module of the LRU cache accurately models the

performance of the LRU cache.

Claim 17   The method of claim 16, wherein determining if the dynamic threshold

accurately models the performance of the LRU cache comprises comparing the

performance of the dynamic threshold with an alternate dynamic threshold.

Claim 18   The method of claim 15, further comprising automatically updating a

dynamic threshold used in the remote model of the LRU cache when another

dynamic threshold is deemed to be more effective.

Claim 19   The method of claim 1, wherein making a cache management decision

comprises deciding to schedule a prefetch, and further comprising scheduling a

prefetch by sending an I?O request to the LRU cache.

Claim 26   The data prefetch scheduling system of claim 21, wherein the remote

prefetch module is configured to model the <u>LRU</u> cache for use in determining

when to prefetch I/O data into the <u>LRU</u> cache.

Claim 27.   The data prefetch scheduling system of claim 21, wherein the remote

prefetch module is configured to prefetch data into the LRU cache according to a priority

scheme that takes into account the run length of each sequential I/O stream.

Claim 29   A remote prefetch module for determining whether to schedule a prefetch

of data into a <u>Least Recently Used (LRU)</u> cache of a computer system, the

prefetch module comprising:

a modeling module configured to model dynamic operation of the <u>LRU</u>

cache;

wherein the modeling module is further configured to provide a model of

data elements currently stored within the <u>LRU</u> cache, wherein each data element

is assigned a priority value according to its history and requested data elements

are assigned a priority value based at least partially on whether a preceding data

element is present in the <u>LRU</u> cache; and

a calculation module configured to make a cache management decision

based upon the model, wherein the cache management decision is at least partially

determined based on intercepting a stream of I/O information from a host to the

<u>LRU</u> cache to locate a requested data element and is further based on whether a

data element preceding the requested data element is present in the <u>LRU</u> cache.

Claim 30   A computer station on a computer network, wherein the computer station

is configured to communicated with a <u>Least Recently Used (LRU)</u> cache coupled

to a storage device of the computer network, the computer station comprising:

a processor; and

a memory configured to store data structures comprising:

a modeling module configured to model dynamic operation of the

<u>LRU</u> cache;

Wherein the modeling module is further configured to provide a

model of data element currently stored within the <u>LRU</u> cache, wherein

each data element is assigned a priority value according to its history and

requested data elements are assigned a priority value based at least

partially on whether a preceding data element is present in the <u>LRU</u> cache;

and

a calculation module configured to make a cache management

decision based upon the module, wherein the cache management decision is at

least partially determined based on intercepting a stream of I/O information from

a host to the <u>LRU</u> cache to locate a request data element and is further based on

whether a data element preceding a requested data element is present in the <u>LRU</u>

cache.

Claim 31   A computer readable medium comprising executable data structures

configured to carry out a method for scheduling prefetches into a <u>Least</u>

<u>recently Used (LRU)</u> cache of a data storage system, the method comprising:

remotely modeling dynamic operation of the <u>LRU</u> cache in a model, the

model including a model of data elements currently stored within the <u>LRU</u> cache;

assigning a priority value to modeled data elements according to their

history;

assigning a priority value to a requested data element based at least

partially on whether a preceding data element is present in the <u>LRU</u> cache;

making a cache management decision based upon the model;

executing prefetches into the <u>LRU</u> cache in response to select cache

management decisions; <u>and</u>

~~making the requested data element a youngest member of the cache.~~

<u>assigning the requested data element as status corresponding to a youngest</u>

<u>member of the LRU cache</u>.

EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

2.   Claims 1, 4, 7-8, 12-21, 23-27, and 29-32 are allowed.

3.   The following is an examiner's statement of reasons for allowance:

Applicant's invention is drawn to a method and apparatus for performing

prefetching operation in the pre-exiting least recently used (LRU) cache in a network

computer system in order to enhances the efficiency of the successful identification of

likely prefetch candidates (i.e., the shared system memory comprising a least-recently-

used-only cache which optimized for random data accesses, a remote prefetch module is provide between the least-recently-used-only cache and the host to conduct prefetching without internally modifying the least-recently-used-only cache, allowing for prefetching a stream of sequential data based upon the expected residency time/occupancy time of objects within an existing native least-recently-used cache, and the remote prefetch module maintains a mode of cache, in corresponding to the prefertch module whether data is likely to be part of a sequential steam of data passed between a host and a data storage device, in order to minimizes impacts to random access data hits by minimizing the likelihood of prefetching data which is not used).

Applicant's independent claims 21, 29, 30 and 32 each recites, *inter alia,* a data prefetch scheduling system (10) with a structure defined in the specification (pages 8-10) comprising an LRU cache (42), and a remote prefetch module (200) with a structure defined in the specification (pages 10-16) configure to intercept a stream of input/output information from the host to a LRU cache to locate a requested data element and further configured to determine whether to schedule a prefetch of data into the LRU cache, wherein the determination to prefetch data is at least partially determined based on whether a data element preceding a requested data element is present in the LRU cache, and further comprising a modeling module operating with the remote prefetch module to model the LRU cache, and assigning a priority value according to each data element's history, and perform a prefetch request module to request a data input/output from the LRU cache when the remote prefetch module determines that a prefetch is to be conducted. Applicant's invention of claims 21, 29, 30 and 32 each comprises a particular combination of elements, which is neither taught nor suggested by the prior art.

Applicant's independent method claims 1, 20 and 31, each recites, *inter alia*, assigning a priority value to modeled data elements according to their history, assigning a priority value to a requested data element based at least partially on whether a preceding data element is present in the LRU cache, and making a cache management decision based upon the model, which further comprising intercepting a request for a data element from a stream of input/output data request sent from a host and addressed to the LRU cache; and determining whether to schedule a prefetch of a data element logically successive to the requested data element in accordance with contents of the LRU cache as indicated by the remote module. Theses steps, in combination of the remaining steps, are neither taught nor suggested by the prior art.

Accordingly, Applicant's claims are allowed for these reasons, and for the reasons recited in the previous Amendments and Remarks.
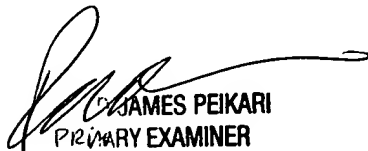
Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

4.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zhuo H. Li whose telephone number is 571-272-4183. The examiner can normally be reached on Tues - Fri 9:00am - 6:30pm and alternate Monday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Matthew Kim can be reached on 571-272-4182. The fax phone number for

the organization where this application or proceeding is assigned is 571-273-8300.

5.   Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR. Status

information for unpublished applications is available through Private PAIR only. For

more information about the PAIR system, see http://pair-direct.uspto.gov. Should you

have questions on access to the Private PAIR system, contact the Electronic Business

Center (EBC) at 866-217-9197 (toll-free).

Zhuo H. Li

JAMES PEIKARI
PRIMARY EXAMINER

Patent Examiner
Art Unit 2185
November 10, 2005